Boonton

170/5-K | 170/5-K1 | 170/5-K2

MP MASTER

MA24316

OPERATING AND SERVICING MANUAL

MODEL 170/5-K
170/5-K1
170/5-K2

AUTOMATIC CAPACITANCE TEST SYSTEMS

201 584-1077

BOONTON ELECTRONICS CORPORATION

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11-72/170/5-K a

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Constituent Units - Model 170/5-K

1. Model 55B Capacitance Reference (Control Unit)
2. Model 71K, 71K-S1 or 71K-S2 Capacitance Meter
3. Reference/Signal Cable - Dwg. No. AX5100-142-1
4. Control Cable - Dwg. No. AX5100-19
5. Output Mating Plug, Cinch Jones, S-321-CCT - Part No. 479214
6. (2) Cx Mating Plugs, BNC UG88/U - Part No. 477117

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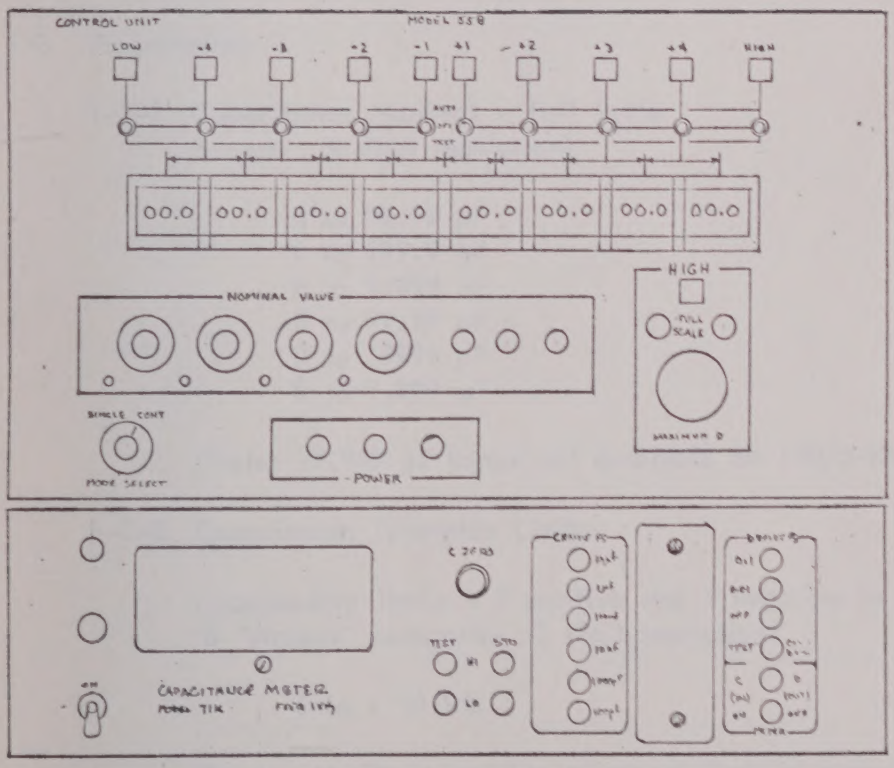

USED ON			TOLERANCES		
			2 PLACE DECIMAL .010 3 PLACE DECIMAL .005 UNLESS OTHERWISE SPECIFIED		
			SCALE:		
			DRN	Dkw	6/1/72
			CKD		
			APP		

BOONTON ELECTRONICS CORPORATION
PARSIPPANY NEW JERSEY

170/5-K PANEL LAYOUT

SH. OF

AX5100-259

1. SPECIFICATIONS

1-1 Excitation Frequency: 1 KHz ± 1%

1-2 Excitation Level:

1-2-1 170/5-K: 1.0 Volt RMS ± 5%

1-2-2 170/5-K1: 0.5 Volt RMS ± 5%

1-2-3 170/5-K2: 2.0 Volt RMS ± 5%

(Note: Excitation level regulation of all models = ± 0.05%)

1-3 Programming:

1-3-1 Capacitance Nominal - Full Scale Ranges: (4 digit resolution)

0 to 99.99 pF
0 to 999.9 pF
0 to 9.999 nF
0 to 99.99 nF
0 to .9999 μF
0 to 9.999 μF

(Note: 9.999 μF Range not available on 170/5-K2)

1-3-2 Capacitance Tolerance Limits:

(Independent limits - 4 positive and 4 negative to encompass 8 "Accept" categories, 3 digit resolution)

0 to ± 99.9%

(Note: Maximum positive tolerance limit is numerically limited to 1.4 x F.S. for ranges of 999.9 pF, 99.99 nF and 9.999 μF)

1-3-3 Dissipation - Full Scale Ranges:

(Single Limit - 10 Turn Potentiometer)

0 to 0.01 (0 - 1% DF)
0 to 0.1 (0 - 10% DF)

1-4 System Accuracy

1-4-1 Capacitance: $\pm (0.1 + \frac{1}{Q})\% \pm 0.01\%$ Full Scale

1-4-2 Dissipation: $\pm$ 2.0% $\pm$ 0.0005

1-5 Test Time: 50 to 175 milliseconds depending on decision (50 mS for ± 1 category, 175 mS for Reject "High" or "Low")

1-6 Measurement Technique: 3-Terminal (Effectively ignores shunt capacitance to ground)

1-7 Test Fixture Compensation: 0 - 50 pF

1-8 Modes of Operation:

1-8-1 Continuous: Free-running interrogation and display of results

1-8-2 Triggered: Interrogation and clamped display upon receipt of "Start Test" Signal

1-8-3 Start Test Signal: External contact closure for 3 mS minimum or push-button panel switch

1-8-4 Test Complete Signal: Contact closure remains actuated until after receipt of next "Start Test" Signal

1-9 Test Results:

1-9-1 Capacitance: Red, green and yellow lamps plus SPST mercury wetted relay contacts indicate High, Accept or Low.

1-9-2 Dissipation: Blue lamp plus SPDT mercury wetted relay contact indicates "D" in excess of established limit. "D" relay may be externally wired to "C" decision common line to inhibit "C" decision upon "D" Reject.

1-10 Internal Calibration Standards:

1-10-1 Capacitance: 10nF (0.01 μF) ± 0.1%

1-10-2 Dissipation: 0.01 (DF = 1%, Q = 100) ± 1.0%

1-11 Power Requirements: 105-125 Volts at 50 to 60 Hz; 100 Watts

1-12 Physical Dimensions: H.W.D. 17" x 20" x 22", 100 lbs. in Scientific Atlanta E-15 Cabinet Enclosure

II. GENERAL DESCRIPTION

The Model 170/5-K Series is a precision, high-speed capacitance measuring system designed for automatic capacitance sorting. The system is an analog device whereby the parameters of Capacitance and Dissipation are reduced to DC voltages and compared to switch selectable limits to sort the unknown in one of eight Accept zones, High or Low Reject for capacitance and Accept or Reject for dissipation.

These models are an integrated combination of one or more of the Boonton Electronics Model 71K series and the Model 55B Capacitance Reference (Control Unit). The actual measurement function is performed in the Model 71K while the comparison and memory circuits are contained in the Model 55B.

In addition to "limit-type" testing, these systems may also be used for precision capacitance and dissipation measurements by setting the capacitance tolerance zone to ± 0% and observing the cross-over of the High and Low lamps as the nominal capacitance value is nulled and cross-over of the dissipation Accept-Reject lamp as the "D" limit is nulled.

The "Triggered" mode of operation for these systems facilitates tie-in with mechanical equipment, as the relay outputs are suitable for commanding auxiliary equipment such as motors and solenoids. Closed loop operation is achieved by utilizing the "Start Test" and "Test Complete" features in the "Triggered" mode.

Rugged industrial construction, utilizing plug-in logic cards and sub-assemblies has been combined with conservative derating practices and quality components to provide equipment capable of unattended operation for long periods of time.

III. OPERATING INSTRUCTIONS

3-1 Initial Procedure

3-1-1 Setting up the Equipment

The constituent units are installed in the cabinet enclosure according to Dwg. No. AX5100-259.

The interunit cables are connected to the rear of the constituent units according to Dwg. No. AX5152-4.

3-1-2 Turning on the Equipment

Individual linecords for each unit are plugged into a multi outlet strip located at the bottom rear of the cabinet enclosure. The single common linecord from this strip should be connected to a power source of the specified voltage and frequency. A third wire ground is provided in the linecords and, for operator protection, should not be defeated.

Power switches on each unit should be turned "On". A power "On" condition will be confirmed by the white pilot lamp on individual units.

3-2 Cx Connections

The capacitor under test should be connected to either the front panel or rear panel mounted "Test" terminals of the Model 71K via a pair of cables as shown on Dwg. No. AX5100-138. The length of the cables is not critical up to approximately twenty (20) feet and may be terminated at the test fixture by a direct solder connection.

Precautions should be taken to maintain shielding and isolation of the test capacitor from external signal sources, especially in cases of capacitance values covered on the two lowest ranges.

Unusually high external series resistance in the test leads should be avoided as it will effect the apparent "D" measurement.

3-3 Connections to External Equipment

3-3-1 Decisions

Decision outputs, plus the Test Complete signal in the form of relay contacts are available at the rear of the Control Unit Model 55B (Output Receptacle J-2).

A mating plug for this receptacle is provided with the Model 170/5-K series.

The pin layout for receptacle J-2 is shown on the Block Diagram, Dwg. No. BX5152-5.

3-3-2 Start Test Signal

Three access points are provided as a means of initiating a test.

A front panel mounted push-button (Manual Start) switch is provided to facilitate manual control.

J-6 and J-7 are provided so that simple connection to a footswitch or other external trigger may be made without wiring into the output connector, J-2.

A momentary contact closure between pins 19 and 20 of J-2 is used when closed loop operation with auxiliary handling equipment is desired.

The minimum time for external closures is 3 milliseconds.

3-3-3 Relay Contact Protection

Except for very light contact loads such as thermocouples and strain gauges, or when used to switch a "dry" circuit, mercury wetted relay contacts must be protected. The protecting device may be a network comprised of resistor and a capacitor in series or a TRIAC (silicon gate-controlled AC switch).

For AC loads, peak values of current and voltage must be used. This assumes the worst conditions.

To reduce the peak voltages in inductive circuits to safe levels, the value of C in the protective network can be increased above the minimum value required for contact protection.

The appropriate value can be determined by measurement of peak values within the first few milliseconds after break of the contacts.

For larger AC loads at currents exceeding the relay contact ratings, if switching transiets (turnoff) tend to effect internal or external circuits, a TRIAC may be used. However, as the "turnoff" occurs when the AC voltage swings through zero, up to a half cycle turn-off delay in the external device may be experienced. Dwg. No. AX5100-50 shows a typical connection of TRIAC protective device.

For R-C netowrks, the chart (Dwg. No. AX5100-51) affords a convenient means of determining the necessary contact protection. Dwg. No. AX5100-50 shows a typical connection of elements.

Dotted lines indicate a typical calculation. To use the chart, the value of load current is first found on the horizontal scale (I). When reading directly up to the sloping capacity line, the value of C is determined from the right-hand scale (C). To find R. read directly up from the load cirrent value to its intersection with the appropriate load voltage line (V). The value of R is then read from the left-hand scale (R).

With DC inductive loads it is also recommended that a diode be placed in parallel with the load to suppress the Ldi/dt kick when the circuit is opened.

3-4 Operating Mode

"Continuous" of "Single" modes of operation are selected by the "Mode Select" switch on the Control Unit panel. The "Single" mode is normally used when the equipment is operating automatically with mechanical handling equipment. The "Continuous" mode is only used for laboratory applications, or in the case that an actual precision measurement of a particular capacitance under test is to be made. (See Operating and Servicing Manual for the Model 55B Control Unit for details).

3-5 Nominal Value and Multiplier (Range) Setting

Nominal value of design center value, for the capacitance under test is established by setting the four (4) decade dials on the Control Unit. The multiplier (or range) is selected by pressing the appropriate Full Scale Range button on the Model 71K. The appropriate decimal point and multiplier lamps will light on the Control Unit panel.

For optimum results the nominal value should not be set below 10% of Full Scale on any range.

3-6 Tolerance Settings

Four (4) independent positive and four (4) independent negative tolerance limits are provided in order to establish eight (8) Accept categories. Each Tolerance limit is set by three (3) digit selector switches.

The tolerance program is written in ascending and descending numerical (%) order from the nominal capacitance value. As many as four (4) positive and four (4) negative Accept categories may be programmed. When less than the maximum number of Tolerances are desired, then the outermost Tolerances are set to 00.0 in order.

Because of over-range limitation, the maximum positive tolerance settings which may be programmed, are numerically limited to 1.4 Full Scale on the 1000 pF, 100 nF and 10 μF ranges.

3-7 Dissipation Limit Setting

The Dissipation Limit is set by selecting the desired Full Scale Range via the appropriate button on the Model 71K and setting the "Maximum D" dial on the Control Unit to the desired number.

Full clockwise on the "Maximum D" control is unity. The number set on the control is multiplied by the lighted indicator lamp to obtain the actual limit.

Set: Control Unit dial to 2-1/2 turns CW or .25 Full Scale
(Small Hand between 2 and 3, large hand at 5)

If at any time the actual capacitance reading is less than 5% of Full Scale, the "D" function of the system is inhibited and the resulting output is interpreted as "D" Accept. It is, therefore, advisable never to operate the unit at less than 10% of Full Scale. If the nominal capacitance under test is below this figure, then it is advisable to use the next lower range.

3-8 Actual Value Measurements

3-8-1 Numerical Capacitance Value

3-8-1-1 Set "Mode Selector" switch to "Continuous"

3-8-1-2 Press "Manual Start" to initiate continuous operation

3-8-1-3 Set all "Tolerance" switches to ± 00.0%

3-8-1-4 Adjust "Nominal Value" decade switches to obtain a toggle point between "High" and "Low" decision lamps. When toggle point is reached, read value of Cx on decade dials.

3-8-2 Per Cent Deviation

3-8-2-1 Set "Mode Selector" switch to "Continuous"

3-8-2-2 Press "Manual Start" button to initiate continuous operation.

3-8-2-3 Set "Nominal Value" decades to the design center value of Cx

3-8-2-4 Set all Tolerance switches to ± 00.0%

3-8-2-5 Adjust the +1 or the -1 tolerance limits to obtain a toggle point between the "High" and +1 "Accept" decision lamps, or between the "Low" and -1 "Accept" decision lamps. Read the value of Cx in terms of per cent deviation from nominal at the toggle point.

3-9 Shielding of Test Capacitor

Careful attention to electrostatic shielding of test specimen is in order, especially when the two lowest ranges are used. No specific recommendations can be made here, as each test jig or mechanical handling device will have individual solutions.

3-10 System Grounding

For optimum test results the entire system, including any test jig or mechanical handling equipment, should be connected to ground (See Paragraph 3-11). Usually the third wire or safety ground on the power linecord will be sufficient. In the event this facility has been defeated, a separate wire from the metallic binding post (J-7) of the Model 55B Control Unit should be connected to ground.

3-11 Measurement Considerations

The input considerations are such that shunt capacitance to ground is ignored at the LO Test Terminal and up to 1000 pF shunt capacitance may be maintained at the HI Test Terminal.

Under no circumstances should "Two-Terminal" measurements be attempted, i.e.: Neither Test Terminal should be connected to ground.

3-12 Control Output Switches

Each capacitance category is provided with an individual three (3) position switch. In the "Auto" position, the decision is routed to the output connector J-2 and visual indication is observed, when applicable. In the Off position, no contact closure or visual indication is possible. A momentary "forced" decision may be made by pressing the switches individually to the "Test" position. The switches will return to "Off" when released. Normal operation requires the switches to all be in "Auto".

IV. THEORY OF OPERATION

Ref: Block Diagram, Dwg. No. BX5152-5
Operating and Servicing Manual for Model 55B
Operating and Servicing Manual for Model 71K

4-1 General

The Model 170/5-K Systems are comprised on one or more of Model 71K series of Capacitance Meters and a Model 55B Control Unit.

The actual measurement is performed in the Model 71K series of Capacitance Meters. The two test parameters of capacitance and dissipation are reduced to DC analog voltages properly scaled to agree with a precision reference voltage. The precision reference voltage is generated in the Model 71K and is used for comparison of the DC analog signals for the purpose of making decisions.

The reference voltage supplied from the Model 71K series is divided and proportioned to produce four (4) positive and four (4) negative limits for capacitance and one (1) limit for dissipation. These capacitance and dissipation reference voltage limits are compared to the analog outputs with two separate differential amplifiers. The amplifier outputs are decoded and displayed as follows:

V_{cx}>V highest limit = Reject High
V_{cx}<V lowest limit = Reject Low
V_{cx} between adjacent programmed V Limits = Accept (C)
1 of up to 8 categories
V_{dx}<V_d limit = Accept
V_{dx}>V_d limit = Reject

All ranges of the 71K Capacitance Meters are scaled to the DC analog output of 0 to +5 Volts Full Scale for capacitance and 0 to +4 Volts for dissipation. Therefore, only a decimal point and multiplier display is required on the Control Unit. Each range is indicated by lamps for the appropriate decimal point and multiplier and is controlled by the range switches on the Model 71K.

V. MAINTENANCE

5-1 General

Under normal circumstances no specific maintenance should be required, and the equipment should provide trouble-free operation for a long period of time.

In the event of malfunction, however, it is suggested that reference be made to the Model 170/5-K Block Diagram, Dwg. No. BX5152-5, and the individual manuals for the constituent units to orient troubleshooting procedures in accordance with amlfunctioning symptoms.

In most cases, this procedure will logically localize the probable trouble to either the Capacitance Meter or Control Unit and upon further logical deductions, as to what oprtion of the individual unit is suspect.

5-2 Calibration

5-2-1 Factory Adjustments

Only the adjustments outlined in the following procedure should be attempted. Read through entire calibration instructions first.

5-2-2 Calibration - Initial (Consult Model 71K Manual for calibration of Model 71K only)

5-2-2-1 Turn on both units

5-2-2-2 Allow 30 minutes warm-up time before making adjustments

5-2-2-3 Make following initial control settings:

a. Model 55B Capacitance Reference Unit
   Nominal Value set to 0000.
   All Tolerance Switches set to 00.0
   Mode Select to "Cont."
   Push and release "Manual Start" button to assure that unit is in "Continuous" Mode

b. Model 71K Capacitance Meter Unit
   100pF range button "in"
   Meter buttons both "in"
   "Test" on "D Off" buttons both "out"
   Adjust "C Zero" knob until meter reads "Zero" (Meter should be at mechanical zero with unit off). This will effectively null out any stray jig or terminal capacitance.

5-2-3 Calibration - Final

5-2-3-1 Set Integrator "Full Scale"
Connect a 10nF (0.01Mfd) standard to the Test Terminals of the Model 71K
Set Nominal value dials on Model 55B to exact value of standards
Adjust R734 (Integrator Full Scale) for crossover of "High" and "Low" lamps.

5-2-3-2 Set Individual Capacitance Range Full Scales
Remove cover plate on Model 71K by pulling two (2) black release buttons on cover plate
Connect standard capacitors of Full Scale value to terminals for each individual range
Set Nominal Value dials to exact value of appropriate standard capacitor for individual range
Adjust "C Adj." for crossover of "High" and "Low" lamps on corresponding range
If adjustment cannot be made on all ranges, reduce or increase "GAIN" and repeat b, c, and d, above.

NOTE: "GAIN" Control effects all ranges equally and normally should not require any adjustment

5-2-3-3 Set individual Dissipation Range
Depress "Test" button and release "Meter D" button
Depress 0.01 "D" range button
Adjust "D.F.S." Control for Full Scale reading on meter
Turn "Maximum D" dial full CW
Adjust R13 ("D" Ref. Adj.) until "D" reject lamp just stays on
Individual low end adjustments are made on each range with a capacitor of known low "D" (0.001 or less) for each range. Adjust each range "D" Zero to this known value.

5-2-4 Internal Test Standard

A built-in Internal Test Standard capacitor is provided for periodic spot checking of correct operation. This is a high-quality, stable, polystyrene dielectric capacitor of 10nF ± 0.1%, which has been adjusted to have a "D" of 0.01 ± 1%.

REVISIONS

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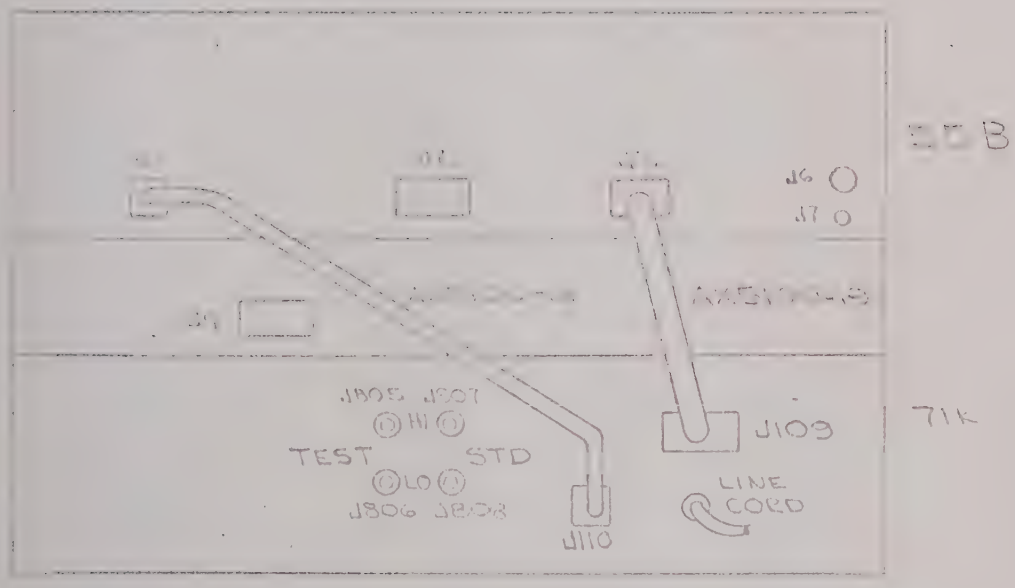
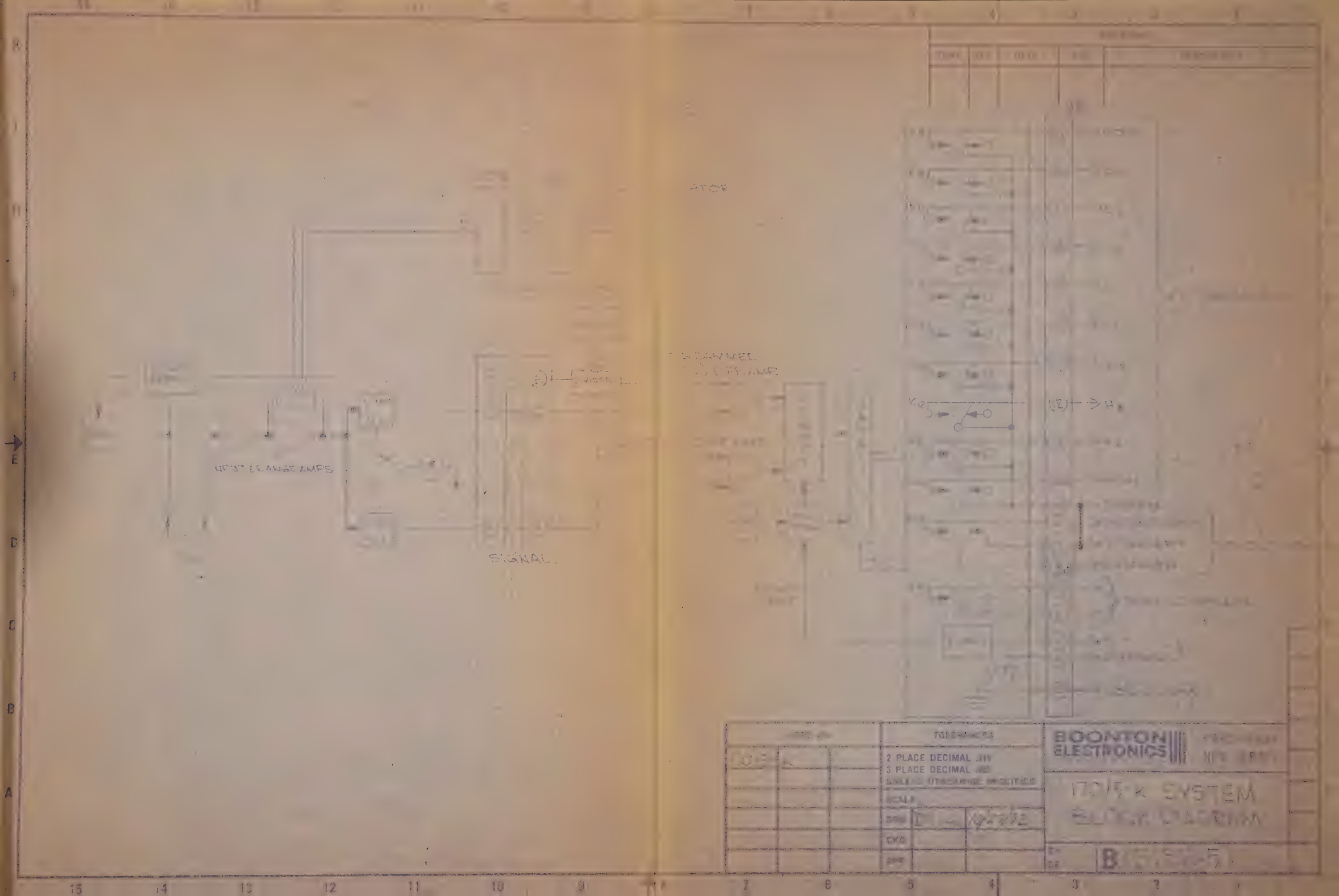


BOONTON ELECTRONICS PARSIPPANY NEW JERSEY

UNIT INTERCOM

MODEL 170/5-1

4/27/72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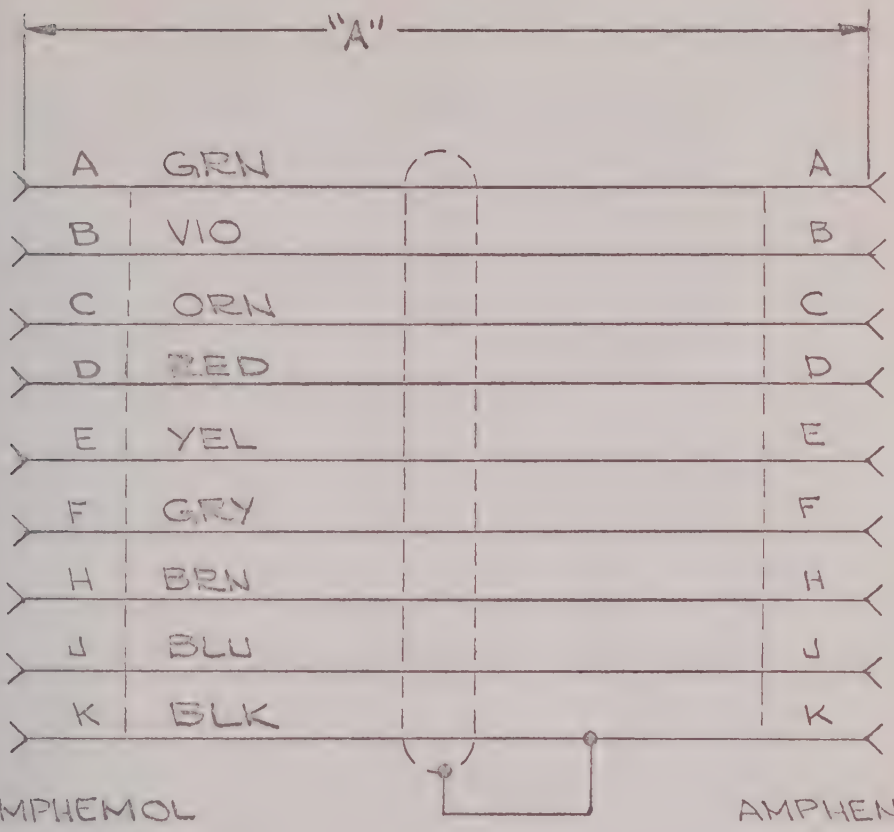

AMPHEMOL
TYPE 165-14
479182

AMPHENOL
TYPE 165-14
479182

-2	6'	571095
-1	4'	571094
[illegible]	"A"	BEC. P.N.

USED ON		

TOLERANCES

2 PLACE DECIMAL .010
3 PLACE DECIMAL .005
UNLESS OTHERWISE SPECIFIED

SCALE:

DRN	[illegible]	4/24/69
CKD		
APP		

BOONTON ELECTRONICS CORPORATION
PARSIPPANY
NEW JERSEY

INTERCONNECTING CABLE

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AX5100-142

M-7-71

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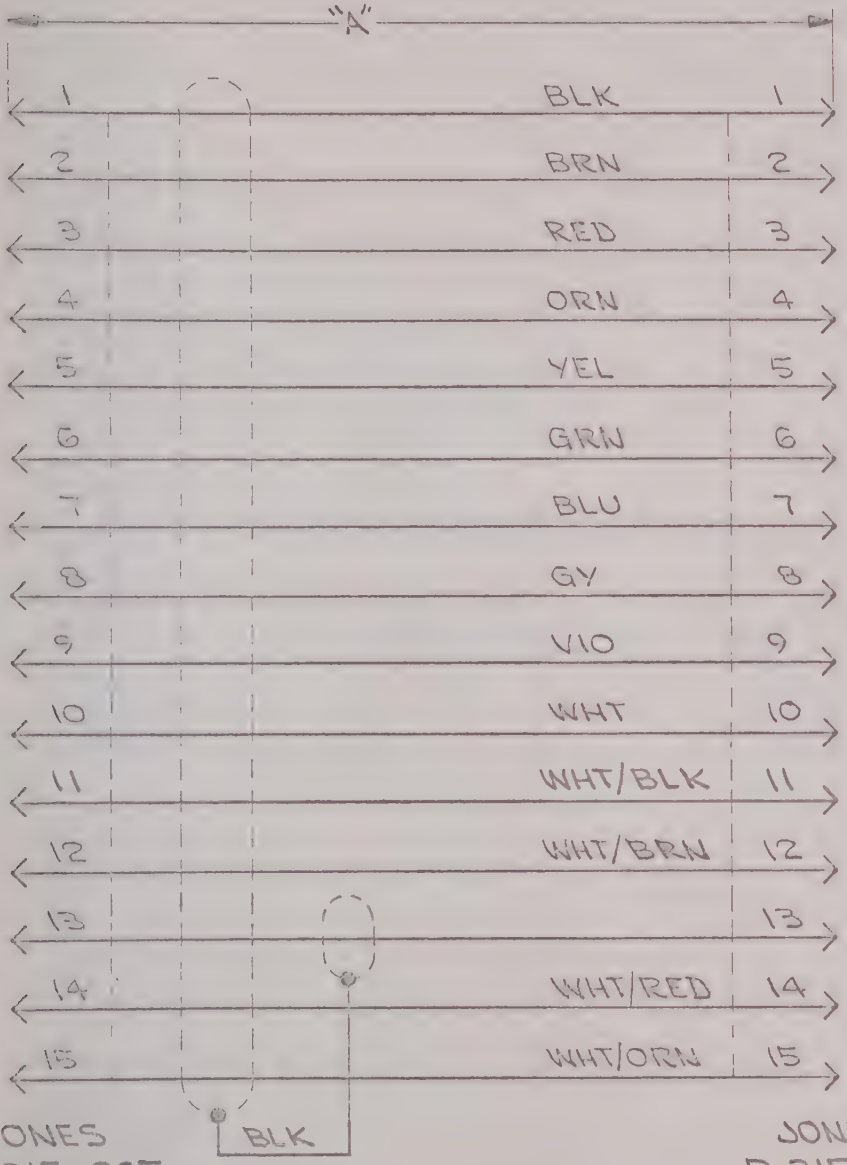

"A"	DASH #	PART NO.
8'	-2	571076
4'	-1	571075

USED ON	TOLERANCES
	2 PLACE DECIMAL .010 3 PLACE DECIMAL .005 UNLESS OTHERWISE SPECIFIED
	SCALE:
DRN CAB	19 MAY 70
CKD	
APP	

BOONTON ELECTRONICS CORPORATION
PARSIPPANY NEW JERSEY

INTERCONNECTING CABLE

SH. OF AX5100-19

REVISIONS				
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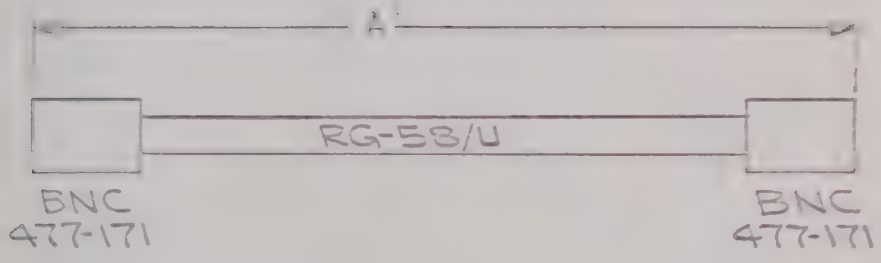

511119	-2	3'
571067	-1	6'
PART NO.	-NO.	"A"

USED ON	TOLERANCES	BOONTON ELECTRONICS PARSIPPANY NEW JERSEY
	2 PLACE DECIMAL .010 3 PLACE DECIMAL .005 UNLESS OTHERWISE SPECIFIED	
	SCALE	INTERCONNECTION CABLE
	DRN [illegible] 11/24/69	
	CKD	
	APP	SIZE AX5100-138

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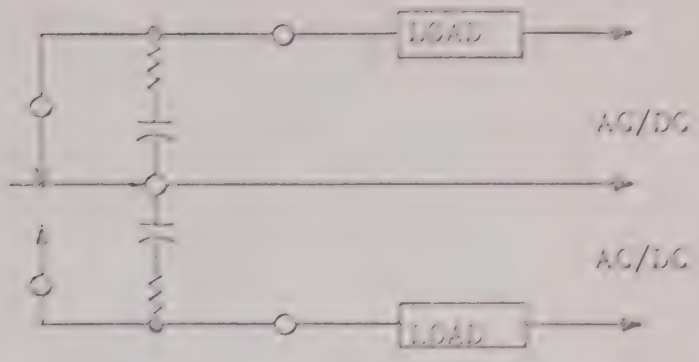
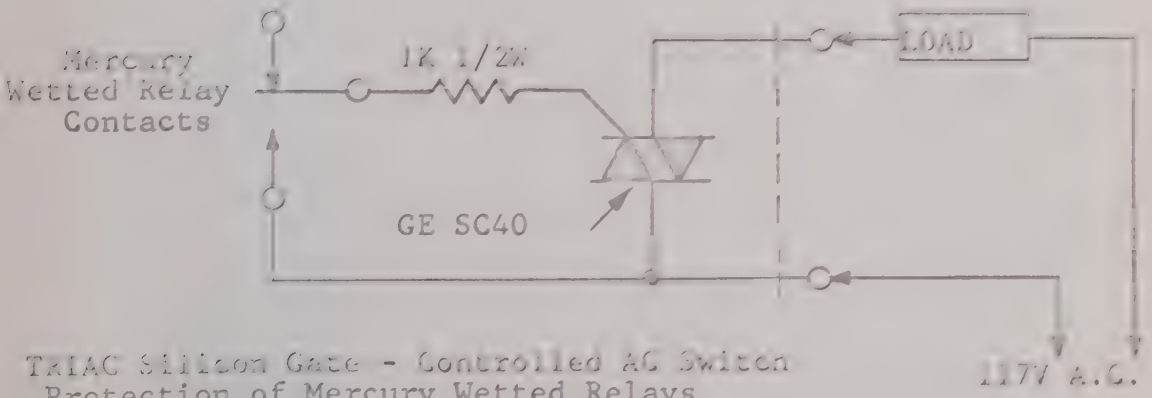


Mercury
Wetted Relay
Contacts

R-C Protection of
Mercury Wetted Relays

PIV - 400V
10A - Continuous
80A - 1 Cycle



TRIAC Silicon Gate - Controlled AC Switch
Protection of Mercury Wetted Relays

USED ON	TOLERANCES	BOONTON ELECTRONICS CORPORATION PARSIPPANY NEW JERSEY
	2 PLACE DECIMAL .010 3 PLACE DECIMAL .005 UNLESS OTHERWISE SPECIFIED	
	SCALE:	Mercury Wetted Relays Contact Protection Schemes
	DRN D.M. 6/17/70	
	CKD	
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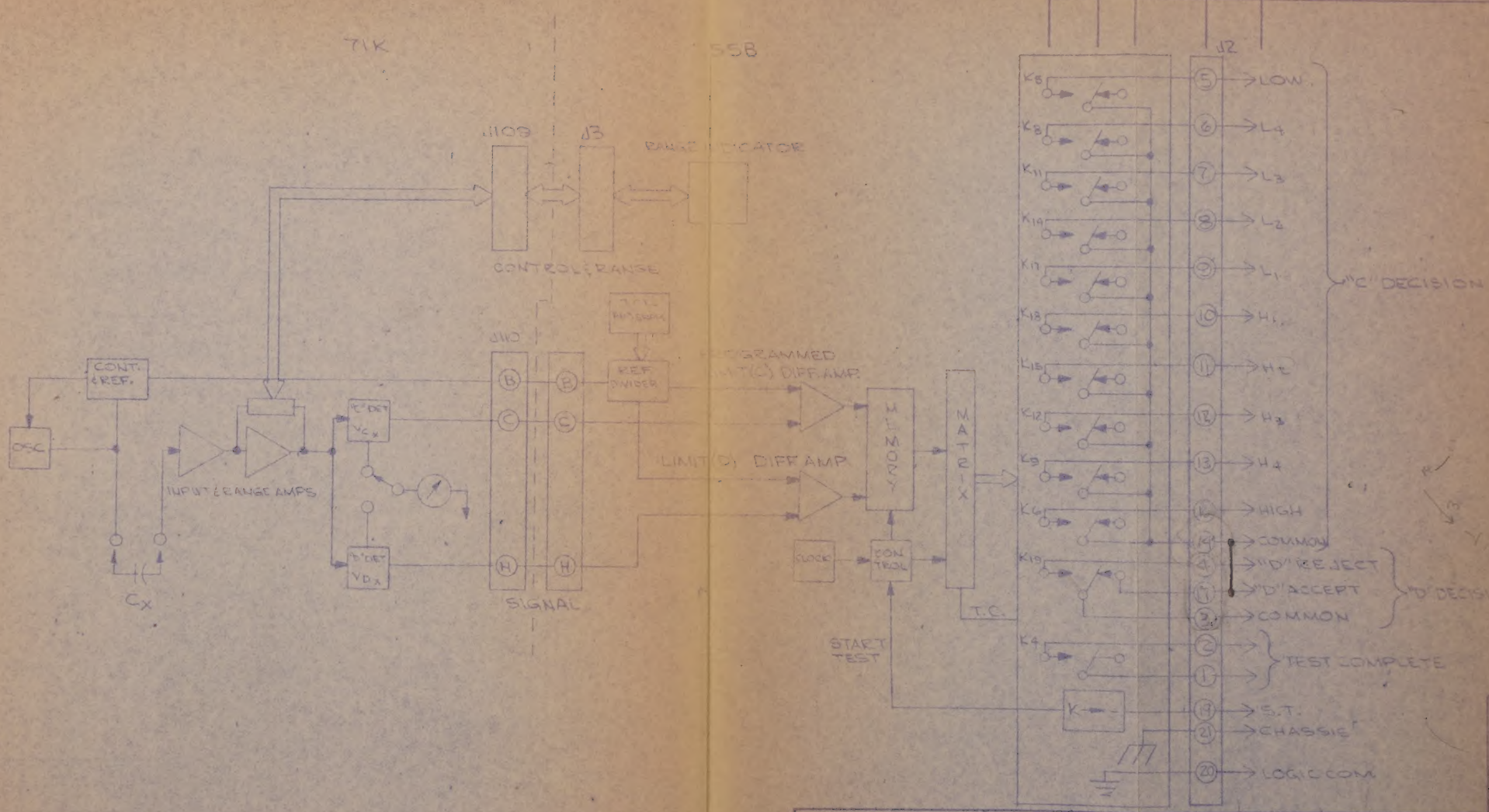

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170/5-K	2 PLACE DECIMAL .010 3 PLACE DECIMAL .005 UNLESS OTHERWISE SPECIFIED	170/5-K SYSTEM BLOCK DIAGRAM	
	SCALE:		
	DRN 10/27/72		
	CKD		
	APP	SH. OF	BX5152-5

ACCOPRESS®

25071	BLACK
25072	LIGHT BLUE
25073	DARK BLUE
25074	LIGHT GRAY
25075	LIGHT GREEN
25076	DARK GREEN
25077	TANGERINE
25078	RED
25079	EXECUTIVE RED
25070	YELLOW

GENUINE PRESSBOARD

ACCO INTERNATIONAL INC
CHICAGO, ILLINOIS 60619

MP MASTER
MA24316